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EPIPHARYNGEAL MORPHOLOGY IN HYPERINI LARVAE (COLEOPTERA, CURCULIONIDAE, HYPERINAE)

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Epipharyngeal Morphology in Hyperini Larvae (Coleoptera, Curculionidae, Hyperinae). Nazarenko V. Yu. — Investigation of the main epipharyngeal structures in representatives of Hyperini weevils larvae has shown that in general case 6 als, 2 (4) ams, 4 mes and 2 snp present: *Coniatus (Bagoides) splendidulus* (Fabricius, 1781) — 6 als, 2 ams, ?1 mes, 2 x 3 snp, *Donus bucovinensis* (Penecke, 1928) — 6 als, 2 ams, 4 mes, 2 x 5 snp, *D. geminus* (Zaslavskij, 1967) — 6 als, 2 ams, 4 mes, 2 x 5 snp, *Hypera (Eirinomorphus) rumicis* (Linnaeus, 1758) — 6 als, ?4 ams, 4 mes, 2 x 2 snp, *H. (Hypera) miles* (Paykull, 1792) — 6 als, ?4 ams, 4 mes, 2 x (4–5) snp, *H. (H.) transsylvanica* (Petri, 1901) — 6 als, 2 ams, 4 mes, 2 x (3–5) snp, *Limobius borealis* (Paykull, 1792) — 6 als, 2 ams, 4 mes, 2 x 4 snp. By morphological peculiarities of epipharyngeal surface the studied larvae can be divided into next 4 groups: 1) epipharynx with wide flat areas, short setae and shallow emargination (*C. splendidulus*); 2) with wide flat areas, medium-sized setae, strait and sharp excision on anterior margin (*D. bucovinensis*, *D. geminus*); 3) with short flat areas, medium to long setae and wide apical emargination (*H. miles*, *H. rumicis*, *H. transsylvanica*); 4) with uneven surface, large long setae and short emargination (*L. borealis*). It is supposed that morphological peculiarities of epipharynx in Hyperini relate to type of feeding.

Key words: Coleoptera, Curculionidae, Hyperinae, Hyperini, weevils, larvae, epipharynx, morphology, chaetotaxy.

Морфология эпифаринкса личинок жуков-долгоносиков трибы Hyperini (Coleoptera, Curculionidae, Hyperinae). Назаренко В. Ю. — Исследования основных морфологических структур эпифаринкса личинок некоторых представителей трибы Hyperini показали, что в общем случае на нём присутствуют 6 als, 2(4) ams, 4 mes and 2 snp: у *Coniatus (Bagoides) splendidulus* (Fabricius, 1781) — 6 als, 2 ams, ?1 mes, 2 x 3 snp, *Donus bucovinensis* (Penecke, 1928) — 6 als, 2 ams, 4 mes, 2 x 5 snp, *D. geminus* (Zaslavskij, 1967) — 6 als, 2 ams, 4 mes, 2 x 5 snp, *Hypera (Eirinomorphus) rumicis* (Linnaeus, 1758) — 6 als, ?4 ams, 4 mes, 2 x 2 snp, *H. (Hypera) miles* (Paykull, 1792) — 6 als, ?4 ams, 4 mes, 2 x (4–5) snp, *H. (H.) transsylvanica* (Petri, 1901) — 6 als, 2 ams, 4 mes, 2 x (3–5) snp, *Limobius borealis* (Paykull, 1792) — 6 als, 2 ams, 4 mes, 2 x 4 snp. По особенностям поверхности эпифаринкса исследованные личинки могут быть распределены на 4 группы: 1) с большими плоскими участками, короткими щетинками и пологой вершинной вырезкой (*C. splendidulus*); 2) с большими уплощёнными участками, средними по величине щетинками, узкой и резкой вершинной вырезкой (*D. bucovinensis*, *D. geminus*); 3) с небольшими участками плоской поверхности, средними или длинными щетинками и широкой вершинной вырезкой (*H. miles*, *H. rumicis*, *H. transsylvanica*); 4) с неровной поверхностью, крупными длинными щетинками и короткой вырезкой (*L. borealis*). Предположительно эти морфологические особенности эпифаринкса связаны с особенностями питания личинок.

Ключевые слова: Coleoptera, Curculionidae, Hyperinae, Hyperini, долгоносики, личинки, эпифаринкс, морфология, хетотаксия.

Introduction

Epipharyngeal (posited on inner side of labrum) structures in Curculionidae larvae have an important significance in taxonomy but remained inaccessible for study in most species of Hyperinae using standard simple technique for a long time because of their modification especially of pigmentation and sclerotization. On the microscopic slides usually only the chaetotaxy of the dorsal surface of the labrum and anterolateral setae are well distinguishable. Sometimes a pair of anteromedian setae is visible in median excision. Studies of other

invisible under light microscopy details require the use of a scanning electron microscope (Skuhrovec, 2004). Information about them in Hyperini is absent or has been known for a few species (Anderson, 1948; Scherf, 1964; May, 1981, 1993; Lee, Morimoto, 1988), f. e. in *Hypera basalis* Voss, 1937 (Lee, Morimoto, 1988) and *Brachypera (Antidonn's) zoilus* (Scopoli, 1763) (May, 1993) larvae where all the basic epipharyngeal structures have been completely described and illustrated.

Material and methods

The separated mouthparts of fixed specimens and exuvia of 7 Hyperini species larvae from 4 genera were investigated. All specimens were collected in natural habits or reared in laboratory from imago captured in different parts of Ukraine in 2002–2009, fixed in ethanol and deposited in Schmalhausen Institute of Zoology.

Dried exuvia and dissected mouthparts were mounted on the microscope stages, covered with gold and examined with scanning microscope JSM 35C (fig. 3, 4) and JSM 6490 LV ("JEOL", Japan) (fig. 1).

The nomenclature used for description of chaetotaxy followed the standard schemes (Emden, 1952; Scherf, 1964; May, 1981, 1993, 1994; Marvaldi, 2003). In general, the weevil larvae epipharynx carries 3 pairs of anterolateral setae (bristles) *als*, 2 pairs of anteromedian (*ams*) and a pair of intermediate setae *ies* with two sensory pores near their base. In the central part of the inner surface of larval epipharynx are 2 pairs of median epipharyngeal setae or spines (*mes*), 2 clusters of sensory pores (*snp*) located therebetween and other single or grouped sensillae marked as "s" here on figures.

General description of epipharyngeal structures in studied species

Coniatus (Bagoides) splendidulus (Fabricius, 1781) (fig. 1, a–d)

Material. 2 mature larvae, Kyiv, Central Botanical Garden, on *Tamarix ramosissima*, 50°24'41.3" N, 30°33'38.3" E, 1.08.2005 (Nazarenko).

Labrum with a shallow emargination at the apex, the central part of which forms a pocket-like fold with a central hole and two blunt tubercles. Epipharynx with large flattened

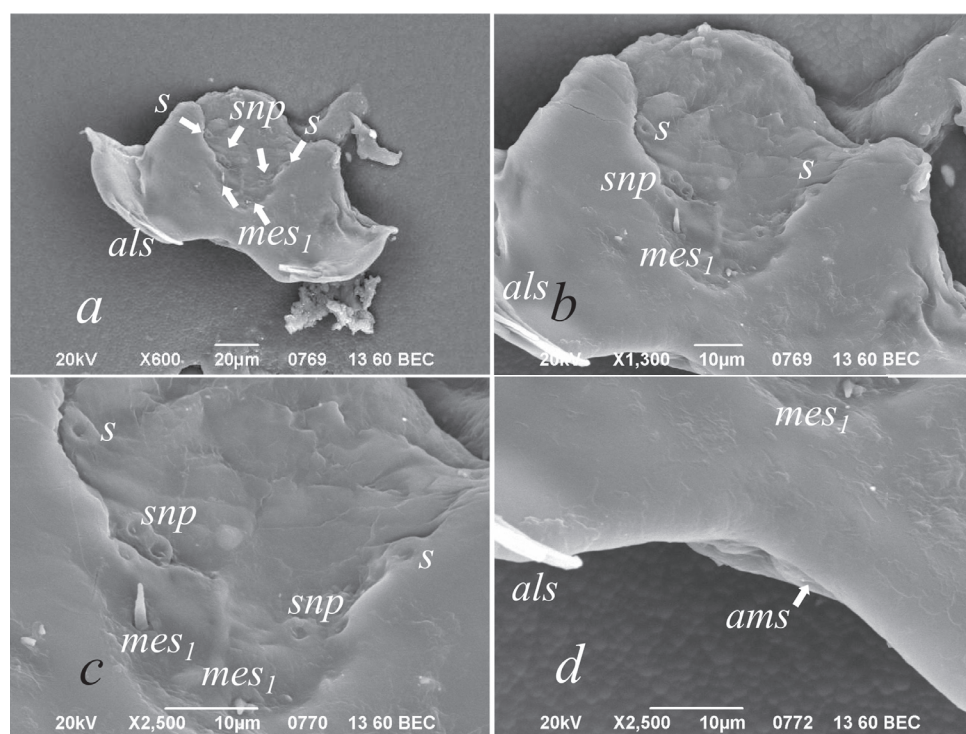


Fig. 1. Epipharynx of *Coniatus splendidulus*: a — general view; b — central portion; c — median impression; d — apical excision. Other abbreviations on this and other figures described in the text.

Рис. 1. Эпифаринкс *Coniatus splendidulus*: a — общий вид; b — центральная часть; c — срединное вдавление; d — вершинная вырезка. Остальные условные обозначения на этом и других рисунках расшифрованы в тексте.

labral rods (tormae) and three impressions near them: central triangular and two lateral at the curved inward outer edges of the labrum. Als_{1-3} with contiguous bases, ams very short and addressed to tubercles in central fold, mes_1 located at the edge of the central depressions between apices of conjunct labral rods. Consisted of 3 sensillae snp placed posteriorly of mes_1 , another pair of sensillae located marginally along the edge of central impression near the bases of labral rods. Mes_2 on the slides indistinguishable, probably absent. Epipharyngeal surface for and between snp with few transverse folds.

Donus bucovinensis (Penecke, 1928) (fig. 2, a, b)

Material. 1 mature larva, Ternopol obl., Gusyatin reg., mt. Gostra, on *Centaurea scabiosa*, 49°21'22.7" N, 26°04'25.7" E, 26.06.2007 (Nazarenko).

Labral frontal edge concave medially. Epipharynx approximately flat with three superficial depressions and scarcely formed labral rods, with the central strait and sharp triangular excision on anterior margin. Als_{1-3} of middle length, ams short and directed inward, mes_1 very short, located in relatively large pits aside the base of central excision. Snp posited posterolaterally of mes_1 at the declivity of central depression and

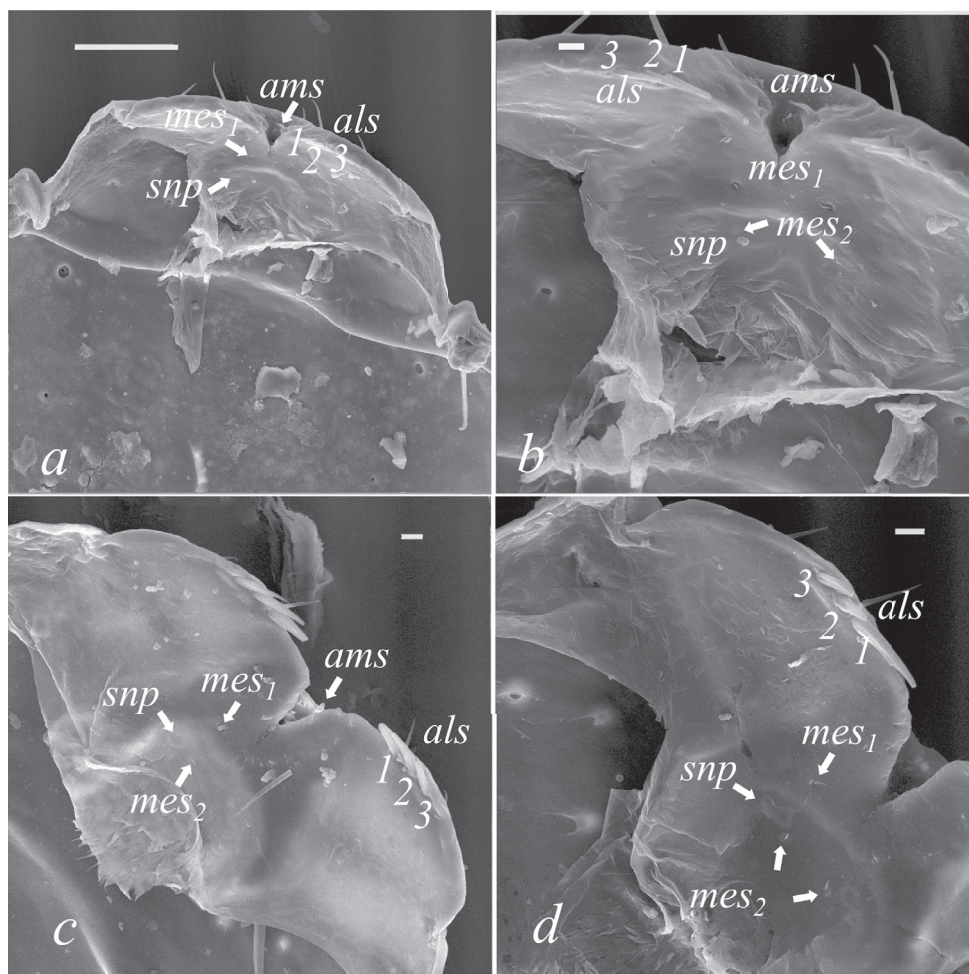


Fig. 2. Epipharynx of *Donus* species: a — *D. bucovinensis*, general view; b — the same, detailed; c — *D. geminus*, general view; d — the same, detailed. Scale bars: a — 100 μ m, b-d — 10 μ m.

Рис. 2. Эпифаринкс некоторых видов рода *Donus*: a — *D. bucovinensis*, общий вид; b — то же, детализировано; c — *D. geminus*, общий вид; d — то же, детализировано. Масштабные линейки: a — 100 мкм, b-d — 10 мкм.

consisted of 5 sensillae. *Mes*₂ placed posteromedially of *snp* in central depression in small indistinct sockets. Distal part of epipharyngeal surface with long flat compound dentiform appendages.

D. geminus (Zaslavskij, 1967) (fig. 2, c, d)

Material. 2 mature larvae, Crimea, road on Ay-Petri mt., on *Psephellus* sp., 44°29'43.9" N, 34°02'06.8" E, 22.04.2002 (Nazarenko).

Epipharynx is the same as in previous species, only the median excision looks longer and deeper, but this may be the result of different alignment of mouthparts during the scanning.

Hypera (Eirinomorphus) rumicis (Linnaeus, 1758) (fig. 3, a–d)

Material. 1 mature, 1 II instar larvae, reared from eggs laid by 2 ♀, collected in Kyiv, Kazachiy isl., 50°19'53.3" N, 30°35'58.5" E, 20.05.2009 (Nazarenko).

Labral frontal edge with a shallow emargination medially. Anterior margin of

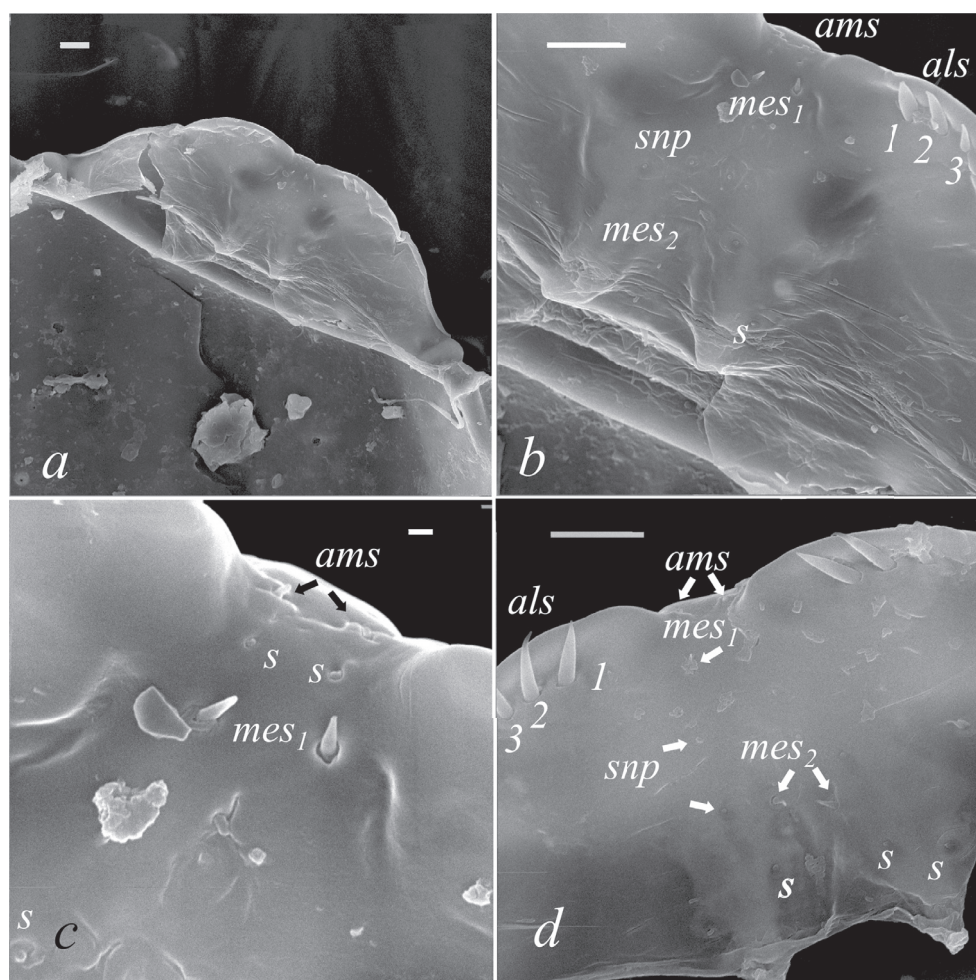


Fig. 3. Epipharynx of *Hypera rumicis*: a — II instar larva, general view; b — median impression; c — apical excision; d — the same of mature larva. Scale bars: a, b, d — 10 μ m, c — 1 μ m.

Рис. 3. Эпифаринкс *Hypera rumicis*: a — личинка второго возраста, общий вид; b — срединное вдавление; c — вершинная вырезка; d — то же взрослой личинки. Масштабные линейки: a, b, d — 10 мкм, c — 1 мкм.

epipharynx with the central flattened subtrapezoidal excision. Labral rods convergent and prominent, epipharyngeal surface with three depressions. Als_{1-3} short, ams very short, placed near frontal edge of epipharynx, behind them located 2 sensillae (reduced or broken ams_2 ?), mes_1 short, placed near the base of central emargination. Consisted of 2 sensillae snp located posterolaterally of mes_1 approximately in the middle of epipharynx. Mes_2 placed posteriorly of snp . 2 sensillae located laterally of mes_2 and 2 pairs of sensillae posteriolaterad on basal parts of labral rods. Distal part of epipharyngeal surface with series of dentiform appendages.

***H. (Hypera) miles* (Paykull, 1792) (fig. 4, a)**

Material. 1 mature larva, Kyiv, on herbaceous plants near ponds on Syrets riv., 50°27'53.8" N, 30°25'24.6" E, 4.06.2003 (Nazarenko).

Labrum slightly sinuate at the middle of apex. Anterior margin of epipharynx with the sharp deep subrectangular central excision. Labral rods distinctly bordered at their inner sides, forming large sharp flattened subtriangular central cavity. Als_{1-3} of middle length, ams short and directed forward with 2 indistinct pits (sensillae?) located posteriorly in the

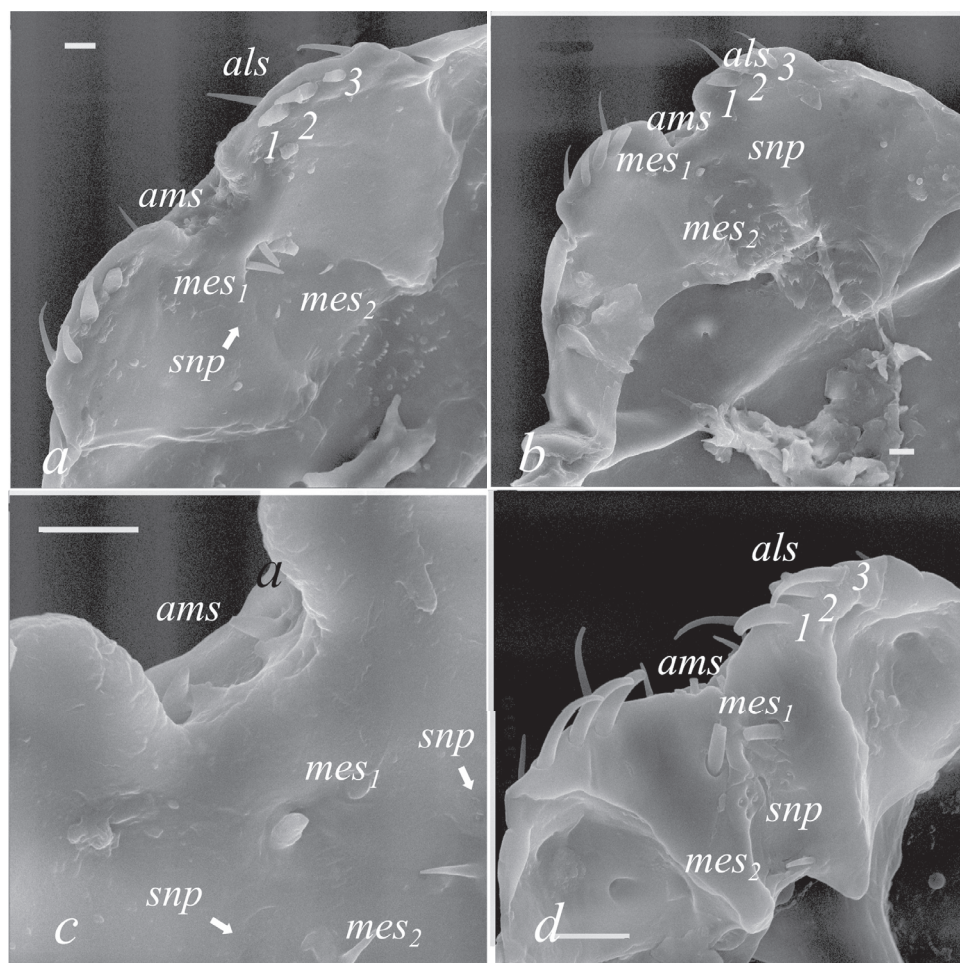


Fig. 4. Epipharynx of *Hypera* species: a — *H. miles*; b — *H. transsylvanica*, general view; c — the same, apical excision; d — *Limobius borealis*. Scale bars 10 μ m.

Рис. 4. Эпифаринкс некоторых видов рода *Hypera*: a — *H. miles*; b — *H. transsylvanica*, общий вид; c — то же, вершинная вырезка; d — *Limobius borealis*. Масштабные линейки 10 мкм.

same excision with *ams*. *Mes*₁ large, directed ventro-posteriad and located close together at the distal part of central cavity. *Snp* posited posterolaterally of *mes*₁ at the sides of central depression and consisted of 4–5 sensillae. *Mes*₂ shorter and more slender, placed posteromedially of *snp* near the sides in central depression. Distal part of epipharynx with transverse toothed folds.

***H. (H.) transsylvanica* (Petri, 1901) (fig. 4, b, c)**

Material. 1 mature larva, Ternopil's'ka obl., Borshchiv Reg., Okopy vill., fortress "Okopy Svyatoy Troitsy", on herbaceous plants, 48°32'22'' N, 26°25'7'' E, 13.06.2009 (Nazarenko).

Labrum slightly emarginate at the middle of apex. Central anterior epipharyngeal excision subrectangular as in *H. miles*. Labral rods distinct, central depression between them suboval. *Als*₁₋₃ approximately as in *H. miles*, *ams* short and directed obliquely forward. *Mes*₁ short, located together at the distal part of central cavity. *Snp* placed near *mes*₂ anterolaterally, consisted of 3–5 sensillae. *Mes*₂ more slender than *mes*₁, located in central depression. Epipharynx in distal part folded with transversal groups of teeth.

***Limobius borealis* (Paykull, 1792) (fig. 4, d)**

Material. 1 mature larva, Kyiv, Central Botanical Garden, on *Geranium* sp., 50°25'05'' N, 30°33'48.7'' E, 28.05.2007 (Nazarenko).

Labrum slightly sinuate at the middle of apex. Anterior margin of epipharynx with the short shallow central excision. Labral rods distinct, prominent, sharply protruding at their bases, forming 3 large flattened longitudinal depressions on epipharyngeal surface. *Als*₁₋₃ large and long, *ams* of middle length, directed forward. *Mes*₁ large, nearly so wide as *als*, widely disposed, located at the apical part of central depression. *Snp* consisted of 4 sensillae, posited posteriorly of *mes*₁ closely together at the sides of central depression. *Mes*₂ of the same length of *mes*₁ but much more slender, located posteriorly of *snp* near the bases of labral rods. Distal part of epipharynx with indistinct transverse folds without teeth.

Discussion

The comparative analysis of the main epipharyngeal structures in representatives of Hyperini weevils larvae (table 1) has shown that in general case 6 *als*, 2(4) *ams*, 4 *mes* and 2 *snp* present. The modal number of *ams* in *Hypera* is 4 (Anderson, 1948); in studied here specimens only in *H. rumicis* recognizable second pair of structures could be interpreted as setae or sensillae near *ams*₁ was found. These morphological features of Hyperini larvae are not unique; the similar setal pattern is known f. e. in Bagoinae (Gosik, 2008) and certain Cyclominae (May, 1977; 1993; 1994; Marvaldi, 1998) with which Hyperinae supposed to be closely related (Zherikhin, Egorov, 1990).

By morphological peculiarities of epipharyngeal surface the studied larvae can be divided into next 4 groups: 1) epipharynx with wide flat areas, short setae and shallow emargination (*C. splendidulus*); 2) with wide flat areas, medium-sized setae, strait and sharp excision on anterior margin (*D. bucovinensis*, *D. geminus*); 3) with short flat areas, medium to long setae and wide apical emargination (*H. miles*, *H. rumicis*, *H. transsylvanica*); 4) with uneven surface, large long setae and short emargination (*L. borealis*).

Since the structure of the insect mouthparts always related to the type and characteristics of peculiarities of food and type of feeding, it can be suggested that structure of epipharyngeal surface in Hyperini has the same dependence. The species with more ectophytic type of feeding (groups 1, 2) have more flattened epipharynx with shortened

Table 1. Epipharyngeal setal indices of studied Hyperini larvae. Data on *H. basalis* and *B. zoilus* is based on publications by Lee, Morimoto (1988) and May (1993)

Таблица 1. Количество эпифарингеальных щетинок у изученных личинок Hyperini. Данные по *H. basalis* и *B. zoilus* приведены из литературных источников (Lee, Morimoto, 1988; May, 1993)

Code of setae	1	2	3	4	5	6	7	8	9
<i>als</i>	6	6	6	6	6	6	4	6	6
<i>ams</i>	2	2	2	?4	?4	2	4	?8	2
<i>mes</i>	?2	4	4	4	4	4	4	2	4
<i>snp</i>	3	5	5	2	4–5	3–5	2+2	5	4
<i>s</i>	–	–	–	6	–	–	–	–	–

Note. 1 — *Coniatus splendidulus*; 2 — *Donus bucovinensis*; 3 — *D. geminus*; 4 — *Hypera rumicis*; 5 — *H. miles*; 6 — *H. transsylvanica*; 7 — *H. basalis*; 8 — *Brachypera zoilus*; 9 — *Limobius borealis*.

*mes*_p, placed in depressions or (and) pits; when feeding occurs preferably in folded leaves, buds, inflorescences etc. (groups 3, 4), labral rods became more prominent, epipharyngeal surface more uneven and *mes* relatively longer and larger. In *L. borealis* (group 4), which larvae usually develop and pupate in flower buds, epipharynx superficially resemble that of cryptophytic larvae of other weevils. Only in this species all the main labral structures could be seen on common slides using optic microscope. Probably in those cases changes in ephiphaynx relate to hardness of plant tissues, which are softer in the stem apical rosettes, young leaves and buds then in developed old leaves (group 2) or in shoots of *Tamarix* (group 1).

On the other hand, these morphological groups straightly match to studied genus-level groups of Hyperini but there are not enough data to make any final conclusion yet. Considering the reduced number of epipharyngeal setae *ams* and number of sensillae in *snp* the features of epipharynx of *L. borealis* resembling those of typical hide-feeding weevils larvae seem to be the secondary.

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